cent disability. My feeling is, however, that if the average man's objective physical findings were made the basis of the award, and his lack of the will to do, evaluated at its true worth in the open market, permanent, partial disability ratings would be materially lower than this paper would show them to be.

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LIONEL D. PRINCE, M. D. (490 Post Street, San Francisco). — Doctor McChesney's paper presents many facts of great interest particularly to those whose practice brings them in frequent contact with injuries to the semilunar cartilages of the knee. In reviewing the cases following the removal of cartilages, a cross section of end results, irrespective of whether the cases are industrial or private, must be given consideration. Of equal importance is the consideration of the history of the case and the symptoms prior to and after operative interference. Doctor McChesney has particularly emphasized this point and I believe that many of the so-called poor results following removal of the joint cartilage are due to the fact that the original symptoms were not wholly the result of cartilage injury. In reviewing many of these postoperative cases in which the results have not been satisfactory there has been considerable doubt in my mind as to whether cartilage injury existed. Unfortunately we not infrequently find knees operated upon for removal of cartilages by surgeons not particularly qualified to do this type of work. Notwithstanding the fact that the records show a damaged cartilage was removed, I am inclined to rely more on the history of injury and description of symptoms than on the operative findings. I recall one case in particular where the patient was operated upon for injury to the internal semilunar cartilage. The case was seen by me after a period of many months owing to the fact that he still complained of symptoms typical of cartilage disturbance. I reoperated and a damaged but otherwise intact semilunar cartilage was still present. What the original operator had removed I was unable to determine.

My experience with surgical removal of the internal semilunar cartilage has probably been more encouraging than that of Doctor McChesney. It is obviously misleading, however, to attempt to judge end results from a collection of cases that have been brought to the attention of the Industrial Accident Commission. These cases are unquestionably the ones in which unsatisfactory results have been obtained. The cases operated upon and in which a satisfactory result has been obtained do not appear in the records of the Commission. In the majority of patients whom I have operated, complete recovery in six to eight weeks has been obtained. These have all been patients in whom there has been little doubt as to the existing pathology, the history and symptoms being typical. In a very few cases the symptoms given by the patient contained factors of disability that could not be accounted for on the basis of cartilage disturbance only. In these patients convalescence was either retarded or some degree of permanent disability resulted. It is very probable that at the time of the injury to the knee more disturbance than just injury to the semilunar cartilage occurred, with the subsequent development of some traumatic arthritis.

In recent cases of disturbance to the cartilage, with locking, every attempt should be made to reduce the cartilage and treat it conservatively before considering operative intervention. If following conservative treatment there is a recurrence of locking, operative removal of the cartilage is definitely indicated and should be done without further delay. A delay in removal of the damaged cartilage may result in a complicating arthritis with permanent disability in the knee joint irrespective whether or not the cartilage is removed.

Regarding operative treatment, the Jones technique is unquestionably the method of choice. Extensive exploratory incisions or the split patella route are not indicated in a simple cartilage operation and their use frequently results in protracted or permanent disabilities.

TWINS—A STUDY OF CERTAIN MENTAL DISORDERS*

PRELIMINARY REPORT

By AARON J. ROSANOFF, M. D.
Los Angeles

DISCUSSION *by Professor Lewis M. Terman, Stanford University; Emil Bogen, M. D., Olive View; Julian M. Wolfsohn, M. D., San Francisco.*

PHYSICIANS have many times observed and reported a familial tendency toward certain nervous and mental disorders. Hence has arisen a theory to the effect that in the etiology of such disorders, hereditary or inborn factors play a more or less important part.

In special researches which have been undertaken in connection with this problem, three different methods have been employed: (1) the statistical method, as, for example, in the studies published by the Francis Galton Laboratory of Eugenics of the University of London; (2) the Mendelian method, as, for example, in the studies published by the Carnegie Institution and the Eugenics Record Office in this country; (3) the method based on study of twins.

The first two methods have furnished more or less significant confirmation of the theory of a hereditary or inborn factor. The last method has not as yet been employed in a thorough-going way, although it has many times been pointed out that cases of mental disorders in twins constitute the most promising clinical material for the purpose in hand.

Extreme views have been expressed on the question of the relative importance of heredity and environment not only in the etiology of mental disorders, but also in connection with other matters. Available data seem to indicate that a generalization on this point is precluded by the nature of things. There seems to be much variation as between the different clinical groups and even as between cases in any one group. There can be little doubt, for example, that in mental deficiency the inborn factors are by far the more important; and it seems equally certain that, in many cases, a psychoneurotic predisposition is so weak that it remains latent for the most part, and is brought to light only under extraordinary environmental conditions.

Taking as another example the clinical group of manic-depressive psychoses, there is strong clinical evidence that in some cases the inborn factors have, in themselves, proved sufficient to determine a mental breakdown, whereas in other cases such breakdown has occurred only under conditions of unusual physical and psychic strains.

For practical psychiatric purposes, it is important to measure for clinical groups and for individual cases the relative parts played in the etiology by inborn and environmental factors. The importance of this matter, however, is not limited to the field of psychiatry. Vast issues of

* Read before the Neuropsychiatry Section of the California Medical Association at the sixtieth annual session, San Francisco, April 27-30, 1931.

policy in education, mental hygiene, and crime prevention must await final decision pending the settlement of this controversial matter.

REFERENCES FROM MEDICAL LITERATURE

In the medical literature one may find a considerable number of reports of cases of mental disorders in twins. The first such report happens to have been made by an American psychiatrist of pioneer days, Benjamin Rush. His observation, however, like a good many others that have been made since his time, was reported merely as a curiosity in medicine, apparently without a full appreciation of its theoretical significance.

It seems to have been first pointed out by Francis Galton that twins are classifiable into two groups—monozygotic and dizygotic; that the hereditary factors are exactly the same in monozygotic twins but not in dizygotic twins; and that, therefore, comparison of the two kinds of twins should be helpful in determining the relative importance of hereditary and environmental factors in the etiology of various diseases as well as in connection with other important matters.

There has been, in recent years, a considerable output of studies made by psychologists pertaining to the question of inborn and acquired factors in the determination of general intelligence. These studies are, as a rule, without any special reference to mental deficiency or other pathological conditions, but they must be considered relevant in this connection; for no one today can question that most cases of mental deficiency represent merely biological variants to be found at the lower end of the curve of distribution, and not, in the strictest sense, disease conditions sharply distinguishable from cases of so-called normal intelligence.

An excellent summary of studies of this type is presented in the following table, which I have copied from Sandiford's "Educational Psychology."

Coefficients of Correlation for Intelligence Among Groups Exhibiting Different Degrees of Genetic Relationship

Group	r
Physically identical twins	0.90
Like-sex twins	0.82
Fraternal twins	0.70
Unlike-sex twins	0.59
Siblings	0.50
Parent-child	0.30
Cousins	0.27
Grandparent-grandchild	0.15
Unrelated children	0.00
Orphans	0.00

Among the conclusions drawn by Sandiford is the following: "The amount of resemblance in general intelligence varies from r = 0 for unrelated individuals to a maximum of r = 0.90 for physically identical twins. Intermediate values are found in accordance with the genetic relationship of the individuals. Therefore, there is an increasing degree of resemblance in general intelligence among human beings with an increasing degree of blood relationship among them. *Ergo,* general intelligence is an inherited trait."

It is not my intention to offer even a partial review of literature in connection with this preliminary report. I wish, however, to call attention to a rather startling study published less than a year ago in Germany by Johannes Lange, under the title "Verbrechen als Schicksal." This study was immediately translated into the English language, and is now available to the English-reading public under the slightly altered but less significant title, "Crime and Destiny."

Lange furnishes an account of thirty pairs of twins of which one or both have exhibited criminal tendencies. Of this material he regarded thirteen pairs of twins as monozygotic and seventeen pairs dizygotic.

In ten of the thirteen pairs of monozygotic twins both were criminal, and quite consistently in a very similar way; and in the remaining three only one was criminal.

In the second group of cases criminal behavior was observed in both twins of only two pairs; in fifteen cases only one of the twins was criminal.

Turning again to the medical case reports of mental disorders in twins, we find not only that the total amount of material reported is surprisingly scant, but also that interest has seemed to be directed almost invariably to cases in which both twins were affected; and that often without special reference to whether the twins were monozygotic or dizygotic. In other words, this kind of material has never been collected in sufficient amount and in such a way as to afford a real opportunity for comparing the two types of twins.

The present investigation has been undertaken for the purpose of collecting a large enough number of cases of mental disorders in twins to be suitable for statistical treatment, at least in connection with the commoner groups of constitutional mental disorders. We are interested in cases in which only one of the twins is affected and not only in cases in which both are affected. We are interested in monozygotic as well as in dizygotic twins, including opposite-sex twins.

SCARCITY OF MATERIAL FOR STUDY

Our problem presents certain difficulties, the principal one being due to the fact that there is no large collection of twins affected with mental disorders to be found in any one limited area. It is our purpose to gather material from every part of the United States and Canada.

Obstetricians report that approximately one birth in eighty is a multiple birth. There is, however, a high mortality among twins, and it is quite doubtful if we can expect to find, say, in the state hospitals more than one patient in two hundred and fifty who has a twin brother or sister living somewhere and accessible to investigation.

We are interested in cases of constitutional mental disorders, but also in alcoholism, drug addiction, criminal careers, juvenile delinquency, and other serious social maladjustments which may occur on the basis of underlying psychiatric conditions.

Accordingly, we look for our material first of all in state hospitals, institutions for the feeble-minded, and penal institutions; and we expect to find some of our material in classes for subnormal children in public schools, among behavior cases in the schools, and in child-guidance clinics.

We have estimated roughly that twenty-five hundred pairs of twins should be available for study in the United States and Canada in connection with such an investigation as ours. This, however, presupposes an amount of coöperation from officials of institutions which is not always to be had. However, we have already had nearly a year's experience in this work, and we have no doubt that we shall be able to collect a minimum of one thousand cases (two thousand individuals) upon which to base our study.

REPORT ON ONE HUNDRED TWENTY-SEVEN SETS OF TWINS AND TRIPLETS

At the present time we can report on 127 cases (255 individuals, there being one set of triplets represented in this material). According to clinical groups, these cases are classifiable as follows:

	Cases
Mental deficiency	49
Mongolian imbecility	2
Epilepsy	6
Schizophrenia	23
Manic-depressive psychoses	11
Drug addiction	1
Delinquency and crime	22
Miscellaneous	13

Among the miscellaneous cases have been included behavior problems in children with no established medical diagnosis, a case of cerebral arteriosclerosis, one of senile dementia, one of general paralysis, etc.

In forty-eight cases the twins have been judged to be monozygotic; in thirty-six cases, dizygotic but of the same sex; and in forty-three cases they are opposite-sex twins.

In sixty-eight cases both twins have been affected; in the remaining fifty-nine, only one. In this respect, however, the three groups of twins present significant contrasts, as follows:

Classification	No. of Cases
Monozygotic, both affected	41
Monozygotic, one affected	7
Same sex, dizygotic, both affected	18
Same sex, dizygotic, one affected	18
Opposite sex, both affected	9
Opposite sex, one affected	34

Interesting comparisons may be made as of different clinical groups, for example, mental deficiency and psychotic disease (including schizophrenia and manic-depressive psychoses):

In our six cases of epilepsy both are affected in the one pair of monozygotic twins, and only one is affected in each of the five pairs of dizygotic twins (same and opposite sexes).

In our two cases of Mongolian imbecility both are affected in the one pair of monozygotic twins, and only one is affected in the other pair which are dizygotic.

Our one case of drug addiction in twins happens to have occurred in monozygotic twins, and both are affected.

An interesting contrast seems to exist between cases of criminalism in adults and delinquency in children, especially if we include in the latter behavior difficulties which fall short of actual delinquency. In the children both twins are usually affected, whether they are monozygotic or dizygotic. To a somewhat lesser extent this is true of opposite-sex twins. In adults both twins are much more apt to be found affected in monozygotic than in dizygotic pairs.

Considerable difficulty is experienced at times in determining whether a given pair of twins of the same sex are to be considered monozygotic or dizygotic. In fact, in a good many cases this distinction cannot be made with complete certainty. It seems inevitable that errors will occur in both directions. However, we believe that when we have gathered an amount of material large enough for statistical treatment the percentage of error will not prove so great as to obscure or invalidate the conclusions.

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DISCUSSION

Professor Lewis M. Terman (Stanford University). I regard Doctor Rosanoff's paper as of very great importance and hope he finds it possible to continue the study until he has covered all of the institutions of the country that can be persuaded to coöperate. In recent years many studies have been made of the resemblance between twins—both identical and fraternal—in intelligence tests scores but little reliable material has been collected on twin resemblance in personality traits and mental abnormalities. A recent study of Lange, translated from the German by Haldane, was the first published research of the general type which Doctor Rosanoff has undertaken, and its results are so challenging that more exhaustive investigation of the problem is imperative.

Every research has its pitfalls, and this is no exception to the rule. In this case probably the greatest danger is that of biased sampling, for the reason that it is easier to find and to include twin pairs when both are institutional inmates than when only one is. Doctor Rosanoff is fully alert to this danger and, in my opinion, will be able to escape it fairly effectively.

During the past year Dr. Harold Carter, Social Science Research Fellow at Stanford, has undertaken a rather minute psychological comparison of identical and fraternal twins in personality traits as measured by several standardized tests of interest attitudes, introversion-extraversion, psychoneurotic tendency, ascendency-submission, mental masculinity-feminity,

	Monozygotic		Dizygotic			
			Same Sex		Opposite Sex	
	Both Affected	One Affected	Both Affected	One Affected	Both Affected	One Affected
Mental deficiency	19	0	6	7	6	11
Psychotic disease	9	4	3	5	1	12

etc. His results to date indicate pretty definitely that the excess resemblance of identical as compared with fraternal twins is about as great in such traits as in intelligence. His data are especially interesting in the case of identical twins of middle age or older who have had unequal education or dissimilar environment. It is, of course, to be regretted that it will not be possible for Doctor Rosanoff to secure detailed psychometric data for his institutional cases. If I were the director of one of the large foundations I should want to subsidize Doctor Rosanoff to give all his time for several years to securing such psychometric data for his twin subjects in institutions throughout the country.

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EMIL BOGEN, M. D. (Olive View).—Undoubtedly there are hereditary as well as environmental factors in the production not only of mental and physical diseases, but also of all of the wide series of individual variations found in normal health. In the evaluation of the relative importance of these factors the study of the relative incidence of various conditions in the different types of twins offers a method of tremendous value. Great credit is due to Doctor Rosanoff for the ambitious program which he has outlined, and for being able to present already, with his own limited resources, the greatest amount of data on this aspect of the constitutional psychoses yet available.

No one knows better than the investigator himself, however, the difficulties in the interpretation of this material. The very establishment of the origin of a pair of twins from a single fertilized ovum, although made highly probable by the presence of a very high degree of physical similarity, may still be open to question. On the other hand, even uniovular twins, though similar in many respects, may differ markedly in others, just as the two sides of the body, in the same individual, are not identical. The existence of mirror imagery between twins, for instance, although of little physical importance, may lead to significant differences in the psychic realm, concomitant, for example, with left-handedness.

The environmental differences surrounding siblings of different age or sex is, of course, apparent. Whether there are any constant factors tending to make the environment of uniovular twins more constant than that of binovular twins of the same sex merits further investigation. The very fact of physical resemblance is apt to lead to similarity in dress, physical care, attitude of others to them, education, etc. Moreover, the tendency in uniovular twins for a strong affection to exist between them, or a devoted leader and follower relationship, leads to similarities of environment and experiences much more marked than holds with binovular twins, where differences in taste and aptitudes, both physical and mental, leads early to differentiation in environment, and where fraternal antipathies much more frequently manifest themselves.

But even more dangerous than those consequent on the difficulty of accurate determination of uniovular and binovular twins, on the existence of marked differences of a hereditary nature even between uniovular twins, and on the greater frequency of similarity of environment in the case of uniovular twins, are the errors that result from the method of obtaining information about them. Unfortunately twinning appears to be unknown among laboratory animals, and so we must study it as it occurs among the armadillos and in man. If the type of twinning present could be determined at all, twin births (which in itself present grave problems in anatomy and embryology) and every pair of twins were followed until death, in a large population, the data obtained might escape the dangers of unbalanced sampling. If the fact of twin birth could be accurately established even for the inmates of the institutions included in Doctor Rosanoff's investigation, much of the error could be avoided.

The extent to which uniovular twins who show the same defect may be more or less readily accessible in a study of this kind than the uniovular twins without such defect may only be conjectured, while binovular twins, even though both suffering from the same condition, may have their relationship overlooked entirely. Too much weight should not be laid on inferences derived from such small figures as have been hitherto available. It is to be hoped that this study will be continued and that sufficient material will be accumulated to justify more intensive analysis of the relationships disclosed. Doctor Rosanoff is indeed to be congratulated upon the extent to which he has already progressed.

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JULIAN M. WOLFSOHN, M. D. (490 Post Street, San Francisco).—This preliminary report, outlined by Doctor Rosanoff, has a far-reaching value. He has envisaged the result that could be obtained by the minute study of inherited characters through this unusual channel, namely, the study of monozygotic twins.

In a previous report I published six cases of identical nervous diseases in monozygotic twins. In one of these cases there was the development of idiopathic epilepsy in both twins at the age of seven, which has persisted, more or less to date, many years after.

Another set of twins were feeble-minded with the same mental retardation, together with spastic diplegia, and certain similar functional and physical anomalies.

It is a tendency among neuropsychiatrists to feel that certain mental disturbances, such as manic-depressive insanity, are biochemical or biophysical changes in cortical nerve cells. The nervous systems in these patients are affected by either heredity or predisposition. I believe it is the inborn factors in these cases that are the important predisposing causes. This is also true in mental deficiencies.

Doctor Rosanoff's idea of studying both types of twins, as did Lange in his paper on "Crime and Destiny," will give a very good index as to whether an individual's symptom complex is inherited or whether it is a disturbance of adventitious cause or extranatal.

One wonders whether inborn factors do not account for many behavioristic disturbances, mental symptoms, and nervous reactions seen in many patients, to a much larger degree than we are willing to admit.

How can one explain, except by an inborn factor, the case of identical twins exactly fourteen years of age, who became afflicted with manic-depressive psychoses of the same type and severity, who were placed in different mental hospitals about three miles apart and had no communication whatsoever for three years, committing suicide in the same way within a short time of each other?

From a physical standpoint one can understand this when one considers that in growth the chromosomes divide longitudinally and not vertically, so that one can conceive how all the inheritable factors are present in each and every cell. Therefore, when the cleavage occurs which results in two individuals instead of a single one, one would expect all the inherent characteristics present in one to be present in the other, even to the texture and convolutions and patterns of the brain. It is not far to stretch one's imagination if one considers the same association tracts would be present in both brains. Therefore the same innate tendencies to the same reaction type. But Doctor Rosanoff will be able to tell us more in the near future the results of his much larger series of cases.

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DOCTOR ROSANOFF (Closing).—It is gratifying to note the interest in the subject of my paper elicited by my preliminary report.

I wish particularly to express my appreciation of the suggestive and encouraging comments offered by Doctors Terman, Bogen, and Wolfsohn in the course of the discussion.

Any interpretation of data contained in this preliminary report must, of course, be regarded as tentative.

As I write these closing remarks at this time, which is seven months after the state conference at which the above preliminary paper was read, I am able to report further progress in the gathering of material for my study. We have now in our files the records of 365 pairs of twins and two sets of triplets with mental disorders. In addition, material is being accumulated for purposes of control. My associate, Mr. Doncaster G. Humm of the University of Southern California, has recently completed the collection of a large amount of material for a control study of the siblings of patients with mental disorders.

The genetic history of intelligence, both average and superior, and the distribution of intelligence in the two sexes are matters which have a bearing on certain problems in the etiology of mental deficiency. For this reason, cases of various types of twins and of groups of siblings of average and superior intelligence are being collected for purposes of further control.

TUBERCULOSIS AMONG ORIENTAL CHILDREN IN SAN FRANCISCO*

By LLOYD B. DICKEY, M. D.
San Francisco

DISCUSSION *by Philip King Brown, M. D., San Francisco; Jacques P. Gray, M. D., San Francisco; Harold K. Faber, M. D., San Francisco.*

IT is a generally accepted belief that the number of children infected with tuberculosis in any community will be proportional to the number of cases of active pulmonary tuberculosis among adults in the same vicinity. With exactly the same opportunities for infection, different groups of children might vary in the amount of active tuberculous disease present, depending upon the several factors of general hygiene in juvenile environment. The amount and quality of food, the availability of fresh air and sunshine, and the amount of space for a child in the home, are all influences which determine whether the original infection will become latent or progress to more active disease.

The incidence of tuberculous infection among San Francisco clinic children is among the lowest of those reported for American and European cities.[1] Because there is in San Francisco a section of the city which has approximately four and one-half times greater mortality from tuberculosis than the rest of the city at large [2] and where conditions of overcrowding might predispose the child population to tuberculous infection, study of the incidence of tuberculosis among the children of this part of the community should be of interest. A preliminary report in slightly less than one-half the number of cases in the present series [3] has already been submitted on the incidence of infection among Oriental children.

STUDY OF TUBERCULOSIS AMONG SAN FRANCISCO ORIENTAL CHILDREN

Materials and Methods.—The cases reported are the children of Oriental parentage attending the children's clinic of the Stanford University Medical School, all of whom were tested regardless of complaint. The intracutaneous method was used, with a dosage of one-tenth cubic centimeter of a 1/1000 dilution of Koch's old tuberculin (one-tenth milligram), and an erythema of five millimeters diameter at forty-eight hours was taken as the minimum reaction for a positive value. This was a part of the study undertaken for the San Francisco Tuberculosis Association during a three-year period from August 1925 to August 1928.

Age	Chinese No. done	Chinese No. pos.	Chinese % pos.	Japanese No. done	Japanese No. pos.	Japanese % pos.	Total Orientals No. done	Total Orientals No. pos.	Total Orientals % pos.
Under 2	15	0	0.0	17	3	17.6	32	3	9.4
2 to 4	20	5	25.0	20	4	20.0	40	9	22.5
4 to 8	39	13	33.3	52	19	36.5	91	32	35.2
8 to 12	29	9	31.0	32	15	46.9	61	24	39.3
12 to 14	16	9	56.3	10	6	60.0	26	15	57.7
Totals	119	36	30.3	131	47	35.9	250	83	33.2

TABLE 1. Incidence of tuberculous infection according to race and age groups.

The incidence among the children of Oriental parentage, using the same age groups as in the preliminary study, is shown in Table 1. When this is charted graphically, it shows the Japanese children to have a higher incidence than the Chinese in all except the preschool group from two to four years, where it is slightly higher among the Chinese (Chart 1). When both Oriental races are compared with the child population at large in San Francisco, the former show a higher incidence in all except the youngest age group, where the percentage of those infected is about the same (Chart 2).

In thirty-three of the Chinese children and in thirty-nine of the Japanese, or in seventy-two of the total of eighty-three positive reactors to tuberculin among the Oriental children, it was possible to secure histories, physical examinations, and roentgenographs in sufficient degree to make presumptive or final diagnoses of the type of tuberculosis present in each child. Table 2 lists the types of disease found, with numbers of cases and percentages among positive reactors in Orientals, as compared with a much larger but similar series, among white children.

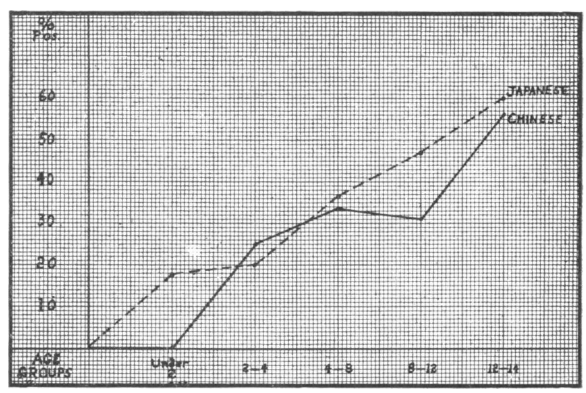

Chart 1.—The incidence for each oriental group, graphically charted.

* From the department of pediatrics, Stanford University Medical School, San Francisco.

* Read before the Pediatrics Section of the California Medical Association at the sixtieth annual session, San Francisco, April 27-30, 1931.